APPENDIX I

ADDITIONAL INFORMATION ON THE PROPOSED ACTION

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Tables

Acronyms/Abbreviations

AF	acre-foot or -feet
RO	reverse osmosis
Se	selenium
TDS	total dissolved solids
Westlands	Westlands Water District

This appendix provides additional information on the proposed action, In-Valley Disposal Alternative.

I1 SUMMARY DESCRIPTION

The In-Valley Disposal Alternative would begin with the installation of tile drains for drainage-impaired lands and a collection system to convey drainwater to agricultural reuse facilities located within each of the four zones. The drainwater would be used to irrigate salt-tolerant crops at the reuse facilities. Subsurface tile drains would be installed to collect the reused drainwater. A reverse osmosis (RO) plant in proximity to the Northerly Area reuse facility would treat reused drainwater collected in this zone. Desalted product water from the RO plant would be blended with Central Valley Project water and used for commercial crop irrigation or, if required, for other project purposes (e.g., wetland mitigation). The RO treatment would also produce a concentrate waste stream requiring further treatment and disposal.

Reused drainwater collected at the Westlands Water District (Westlands) reuse facilities and RO concentrate from the Northerly Area would be conveyed via pipeline to regional treatment and disposal facilities. These regional facilities would consist of biological treatment reactors for selenium (Se) removal and evaporation ponds to reduce the reused and treated drainwater to a dry salt. The residual dry salt would be buried in place at the regional facility for permanent disposal. The sludge generated in the biological treatment will likely be classified as hazardous and will require off-site disposal. Drainwaters impounded in the evaporation ponds would contain Se at concentrations that would be harmful to wildlife. Mitigation facilities would be constructed to provide alternative habitat and compensation for the adverse biological impacts.

I2 DRAINAGE QUANTITY AND QUALITY

Projections of the quantity of drained acres over a 49-year period are found in the *Source Control Memorandum* (URS 2002). These projections were reduced to account for commercial farmland that would be converted to reuse, evaporation, and mitigation facilities during the implementation of drainage service. It is assumed that Westlands and the Northerly Area would generate 0.5 and 0.6 acre-foot (AF) of drainwater per acre of drained land, respectively (*Source Control Memorandum*, URS 2002). The quantity of drainwater requiring treatment and disposal is further reduced by implementation of three drainwater reduction measures: shallow groundwater management, seepage reduction, and recycling.

Drainwater would be conveyed to the regional reuse facilities to irrigate salt-tolerant crops. It is assumed that drainwater would be applied at a rate of 4 AF/acre in the reuse facilities with a 27 percent leaching rate. Approximately 73 percent of the original drainwater would be lost to evapotranspiration. The remaining drainwater would be collected in tile drains and conveyed to the treatment and disposal facilities. The water quality of the reused drainwater initially would be the same as the water quality of the perched aquifer beneath the reuse facility. It is expected that water quality of the perched aquifer would gradually decline during long-term use as do all aquifers underlying irrigated farmlands.

Projections of commercial farmland requiring drainage and drainage quantities without source control, with source control, and after reuse are shown in Table I-1. Projections of the

Table I-1
Projected Drainage Quantities

Year	Acres Drained				Drainage w/o Source Control (AF)				Drainage With Source Control (AF)					Drainage After Reuse (AF)				
	Northerly Area	Westlands North	Westlands Central	Westlands South	Northerly Area	Westlands North	Westlands Central	Westlands South	Northerly Area	Westlands North	Westlands Central	Westlands South	Total	Northerly Area	Westlands North	Westlands Central	Westlands South	Total
1	48,000	5,000	0	0	44,200	2,500	0	0	37,220	2,500	0	0	39,720	10,049	675	0	0	10,724
2	48,333	7,750	3,107	3,108	44,400	3,875	1,553	1,554	35,938	3,111	1,207	1,203	41,460	9,703	840	326	325	11,194
3	48,667	9,128	4,488	4,489	44,600	4,564	2,244	2,245	34,658	3,665	1,744	1,738	41,804	9,358	989	471	469	11,287
4	49,000	10,506	5,869	5,870	44,800	5,253	2,934	2,935	33,379	4,218	2,280	2,272	42,150	9,012	1,139	616	614	11,380
5	49,333	11,883	7,250	7,252	45,000	5,942	3,625	3,626	32,102	4,771	2,817	2,807	42,497	8,668	1,288	761	758	11,474
6	49,667	13,261	8,630	8,633	45,200	6,631	4,315	4,316	30,827	5,324	3,354	3,342	42,846	8,323	1,437	905	902	11,568
7	50,000	14,639	10,011	10,014	45,400	7,319	5,006	5,007	31,153	5,877	3,890	3,876	44,797	8,411	1,587	1,050	1,047	12,095
8	50,333	16,017	11,392	11,395	45,600	8,008	5,696	5,698	31,481	6,430	4,427	4,411	46,749	8,500	1,736	1,195	1,191	12,622
9	50,667	17,394	12,773	12,776	45,800	8,697	6,387	6,388	31,811	6,983	4,963	4,946	48,703	8,589	1,886	1,340	1,335	13,150
10	51,000	18,772	14,154	14,158	46,000	9,386	7,077	7,079	32,142	7,536	5,500	5,480	50,659	8,678	2,035	1,485	1,480	13,678
11	51,333	19,099	15,373	15,504	46,200	9,549	7,687	7,752	32,475	7,667	5,974	6,002	52,118	8,768	2,070	1,613	1,620	14,072
12	51,404	20,173	16,668	16,614	46,242	10,087	8,334	8,307	32,546	8,099	6,477	6,431	53,552	8,787	2,187	1,749	1,736	14,459
13	51,474	21,248	17,962	17,724	46,284	10,624	8,981	8,862	32,616	8,530	6,980	6,861	54,987	8,806	2,303	1,884	1,852	14,846
14	51,544	22,323	19,257	18,834	46,326	11,161	9,628	9,417	32,687	8,962	7,483	7,290	56,422	8,825	2,420	2,020	1,968	15,234
15	51,614	23,398	20,551	19,943	46,368	11,699	10,276	9,972	32,757	9,393	7,986	7,720	57,856	8,844	2,536	2,156	2,084	15,621
16	51,684	24,472	21,846	21,053	46,411	12,236	10,923	10,527	32,828	9,825	8,489	8,150	59,291	8,863	2,653	2,292	2,200	16,009
17	51,754	25,547	23,141	22,163	46,453	12,774	11,570	11,081	32,898	10,256	8,992	8,579	60,726	8,883	2,769	2,428	2,316	16,396
18	51,825	26,622	24,435	23,273	46,495	13,311	12,218	11,636	32,969	10,688	9,495	9,009	62,161	8,902	2,886	2,564	2,432	16,783
19	51,895	27,697	25,730	24,383	46,537	13,848	12,865	12,191	33,040	11,119	9,998	9,438	63,596	8,921	3,002	2,699	2,548	17,171
20	51,965	28,772	27,024	25,492	46,579	14,386	13,512	12,746	33,111	11,551	10,501	9,868	65,031	8,940	3,119	2,835	2,664	17,558
21	52,035	29,846	28,319	26,602	46,621	14,923	14,159	13,301	33,182	11,982	11,004	10,298	66,466	8,959	3,235	2,971	2,780	17,946
22	52,105	30,921	29,613	27,712	46,663	15,461	14,807	13,856	33,253	12,414	11,507	10,727	67,901	8,978	3,352	3,107	2,896	18,333
23	52,175	31,996	30,908	28,822	46,705	15,998	15,454	14,411	33,324	12,845	12,010	11,157	69,336	8,998	3,468	3,243	3,012	18,721
24	52,246	33,071	32,203	29,931	46,747	16,535	16,101	14,966	33,395	13,277	12,513	11,586	70,772	9,017	3,585	3,379	3,128	19,108
25	52,316	34,145	33,497	31,041	46,789	17,073	16,749	15,521	33,467	13,708	13,016	12,016	72,207	9,036	3,701	3,514	3,244	19,496
26	52,386	35,220	34,792	32,151	46,832	17,610	17,396	16,076	33,538	14,140	13,519	12,446	73,643	9,055	3,818	3,650	3,360	19,883
27	52,456	36,295	36,086	33,261	46,874	18,147	18,043	16,630	33,609	14,571	14,022	12,875	75,078	9,075	3,934	3,786	3,476	20,271
28	52,526	37,370	37,381	34,371	46,916	18,685	18,690	17,185	33,681	15,003	14,525	13,305	76,514	9,094	4,051	3,922	3,592	20,659
29	52,596	38,444	38,675	35,480	46,958	19,222	19,338	17,740	33,753	15,434	15,028	13,734	77,949	9,113	4,167	4,058	3,708	21,046
30	52,667	39,519	39,970	36,590	47,000	19,760	19,985	18,295	33,824	15,866	15,531	14,164	79,385	9,133	4,284	4,193	3,824	21,434
31	52,737	40,594	41,265	37,700	47,042	20,297	20,632	18,850	33,896	16,297	16,034	14,594	80,821	9,152	4,400	4,329	3,940	21,822
32	52,807	41,669	42,559	38,810	47,084	20,834	21,280	19,405	33,968	16,729	16,537	15,023	82,257	9,171	4,517	4,465	4,056	22,209
33	52,877	42,744	43,854	39,919	47,126	21,372	21,927	19,960	34,040	17,160	17,040	15,453	83,693	9,191	4,633	4,601	4,172	22,597
34	52,947	43,818	45,148	41,029	47,168	21,909	22,574	20,515	34,112	17,592	17,543	15,882	85,129	9,210	4,750	4,737	4,288	22,985
35	53,018	44,893	46,443	42,139	47,211	22,447	23,221	21,070	34,184	18,023	18,046	16,312	86,565	9,230	4,866	4,873	4,404	23,373
36	53,088	45,968	47,738	43,249	47,253	22,984	23,869	21,624	34,256	18,455	18,549	16,741	88,002	9,249	4,983	5,008	4,520	23,760
37	53,158	47,043	49,032	44,359	47,295	23,521	24,516	22,179	34,328	18,886	19,052	17,171	89,438	9,269	5,099	5,144	4,636	24,148
38	53,228	48,117	50,327	45,468	47,337	24,059	25,163	22,734	34,400	19,318	19,556	17,601	90,874	9,288	5,216	5,280	4,752	24,536
39	53,298	49,192	51,621	46,578	47,379	24,596	25,811	23,289	34,473	19,749	20,059	18,030	92,311	9,308	5,332	5,416	4,868	24,924
40	53,368	50,267	52,916	47,688	47,421	25,134	26,458	23,844	34,545	20,181	20,562	18,460	93,747	9,327	5,449	5,552	4,984	25,312
41	53,439	51,342	54,210	48,798	47,463	25,671	27,105	24,399	34,617	20,612	21,065	18,889	95,184	9,347	5,565	5,687	5,100	25,700
42	53,509	52,417	55,505	49,908	47,505	26,208	27,752	24,954	34,690	21,044	21,568	19,319	96,620	9,366	5,682	5,823	5,216	26,088
43	53,579	53,491	56,800	51,017	47,547	26,746	28,400	25,509	34,763	21,475	22,071	19,749	98,057	9,386	5,798	5,959	5,332	26,475
44	53,649	54,566	58,094	52,127	47,589	27,283	29,047	26,064	34,835	21,907	22,574	20,178	99,494	9,406	5,915	6,095	5,448	26,863
45	53,719	55,641	59,389	53,237	47,632	27,820	29,694	26,618	34,908	22,338	23,077	20,608	100,931	9,425	6,031	6,231	5,564	27,251
46	53,789	56,716	60,683	54,347	47,674	28,358	30,342	27,173	34,981	22,770	23,580	21,037	102,368	9,445	6,148	6,367	5,680	27,639
47	53,860	57,790	61,978	55,456	47,716	28,895	30,989	27,728	35,054	23,201	24,083	21,467	103,805	9,465	6,264	6,502	5,796	28,027
48	53,930	58,865	63,272	56,566	47,758	29,433	31,636	28,283	35,127	23,633	24,586	21,897	105,242	9,484	6,381	6,638	5,912	28,415
49	54,000	59,940	64,567	57,676	47,800	29,970	32,284	28,838	35,200	24,064	25,089	22,326	106,679	9,504	6,497	6,774	6,028	28,803

concentrations of total dissolved solids (TDS), Se, and boron in the initial and reused drainwater are shown in Table 15 and on Figures 6 to 9 in the *Source Control Memorandum* (URS 2002).

Drainwater flows from commercial farms are subject to seasonal variability due to irrigation practices. The seasonal variations for Westlands and the Northerly Area are shown on Figure 4 of the *Source Control Memorandum* (URS 2002). As discussed in Section 3, it is assumed that these seasonal flow variations can be attenuated within the reuse facilities. The storage capacity of the groundwater aquifer beneath the regional reuse facilities could be used to regulate the season variations in the drainwater outflows. Valves would be installed on the drainwater collection system to maintain a constant discharge flow while the water table would rise and fall in response to the varying irrigation inflows. There are three substantial benefits in maintaining constant drainwater flow rates:

1. The required capacity of all treatment and conveyance features downstream of the reuse facilities can be sized for the average annual flow rates, which amounts to a 33 percent reduction from the capacities that would otherwise be required to handle peak flows.
2. All energy-consuming equipment (e.g., pumps and motors) can be designed for constant energy loads, which result in reduced equipment and maintenance costs, reduced energy consumption, and less expensive energy rates compared to a variable energy demand system.
3. Surface storage, in the form of regulating reservoirs, would not be required, thus eliminating a potentially significant contaminant hazard and exposure pathway for Se bioaccumulation.

I3 REVERSE OSMOSIS TREATMENT

Reused drainwater from the Northerly Area would be treated by a RO plant to produce high-quality product water that could be blended with Central Valley Project water for use in irrigation. Preliminary designs and costs are based on existing water quality data from Grassland Drainage Area (*Grassland Bypass Project EIS/EIR* [Reclamation 2001]) and projections of water quality changes (*Source Control Memorandum* [URS 2002]) in the Northerly Area reuse facility. The plant would treat the average annual flow rate from the Northerly Area reuse facility and would operate at about 50 percent recovery. Projections of the concentrations of TDS, Se, and boron in the RO feedwater, product water, and concentrate are tabulated in Table I-2.

The existing water quality data indicate that the reused drainwater would be saturated with respect to calcium sulfate that would tend to precipitate on the membrane surface during RO treatment. An antiscalant chemical would be injected into the filtered drainwater to prevent scale formation on the membranes. The potential for scale formation increases in proportion to the increase in feedwater TDS (see Table I-2). Scale formation would be prevented by greater dosages of antiscalant during the project life.

The RO system would consist of a single-stage, single-pass array to achieve 50 percent recovery and would utilize standard 8-inch, spiral-wound polyamide membranes. The pressure required for RO treatment increases with the TDS concentration. It is projected that the feedwater pressure would initially be about 200 psi and it would gradually increase to about 330 psi after 50 years. It is assumed that the product water would be conveyed to and blended with Central Valley Project water in a nearby canal. The concentrate stream would be conveyed to a biotreatment facility for removal of Se and later to an evaporation facility for disposal.

Table I-2
Projected Concentrations of Reverse Osmosis Streams

Year	Feedwater Quality (mg/L)			Product Quality (mg/L)			Concentrate Quality (mg/L)		
	TDS	Se	B	TDS	Se	B	TDS	Se	B
1	5,200	0.160	11	78	0.002	8.8	10,300	0.318	13
2	5,560	0.172	11	83	0.003	9.0	11,000	0.341	13
3	5,920	0.184	11	89	0.003	9.1	11,800	0.365	14
4	6,280	0.196	12	94	0.003	9.3	12,500	0.389	14
5	6,640	0.208	12	100	0.003	9.5	13,200	0.413	14
6	7,000	0.220	12	105	0.003	10	13,900	0.437	14
7	7,360	0.232	12	110	0.003	10	14,600	0.461	15
8	7,720	0.244	12	116	0.004	10	15,300	0.484	15
9	8,080	0.256	13	121	0.004	10	16,000	0.508	15
10	8,440	0.268	13	127	0.004	10	16,800	0.532	15
11	8,800	0.280	13	132	0.004	10	17,500	0.556	16
12	8,830	0.281	13	132	0.004	11	17,500	0.558	16
13	8,860	0.282	13	133	0.004	11	17,600	0.560	16
14	8,890	0.283	14	133	0.004	11	17,600	0.562	16
15	8,930	0.284	14	134	0.004	11	17,700	0.564	17
16	8,960	0.285	14	134	0.004	11	17,800	0.566	17
17	8,990	0.286	14	135	0.004	11	17,800	0.568	17
18	9,020	0.287	15	135	0.004	12	17,900	0.570	17
19	9,050	0.288	15	136	0.004	12	18,000	0.572	18
20	9,080	0.289	15	136	0.004	12	18,000	0.575	18
21	9,120	0.291	15	137	0.004	12	18,100	0.577	18
22	9,150	0.292	15	137	0.004	12	18,200	0.579	18
23	9,180	0.293	16	138	0.004	12	18,200	0.581	19
24	9,210	0.294	16	138	0.004	13	18,300	0.583	19
25	9,240	0.295	16	139	0.004	13	18,300	0.585	19
26	9,270	0.296	16	139	0.004	13	18,400	0.587	19
27	9,310	0.297	16	140	0.004	13	18,500	0.589	20
28	9,340	0.298	17	140	0.004	13	18,500	0.591	20
29	9,370	0.299	17	141	0.004	13	18,600	0.593	20
30	9,400	0.300	17	141	0.004	14	18,700	0.595	20
31	9,430	0.301	17	141	0.005	14	18,700	0.597	21
32	9,460	0.302	17	142	0.005	14	18,800	0.600	21
33	9,490	0.303	18	142	0.005	14	18,800	0.602	21
34	9,530	0.304	18	143	0.005	14	18,900	0.604	21
35	9,560	0.305	18	143	0.005	14	19,000	0.606	22
36	9,590	0.306	18	144	0.005	15	19,000	0.608	22
37	9,620	0.307	18	144	0.005	15	19,100	0.610	22
38	9,650	0.308	19	145	0.005	15	19,200	0.612	22
39	9,680	0.309	19	145	0.005	15	19,200	0.614	23
40	9,720	0.310	19	146	0.005	15	19,300	0.616	23
41	9,750	0.312	19	146	0.005	15	19,400	0.618	23
42	9,780	0.313	20	147	0.005	16	19,400	0.620	23
43	9,810	0.314	20	147	0.005	16	19,500	0.622	24
44	9,840	0.315	20	148	0.005	16	19,500	0.625	24
45	9,870	0.316	20	148	0.005	16	19,600	0.627	24
46	9,910	0.317	20	149	0.005	16	19,700	0.629	24
47	9,940	0.318	21	149	0.005	16	19,700	0.631	25
48	9,970	0.319	21	150	0.005	17	19,800	0.633	25
49	10,000	0.320	21	150	0.005	17	19,900	0.635	25

I4 SELENIUM BIOTREATMENT

Reused drainwater from the Westlands reuse facilities would be treated for Se removal to reduce the Se concentrations to levels more suitable for evaporation pond disposal. In addition, the concentrate stream from the RO facility would also be conveyed to a Se treatment facility prior to disposal at the evaporation ponds. The concentrate stream from the RO facility and the reused drainwater from the Westlands North reuse facility would be conveyed via pipeline to a northern Se treatment facility located adjacent to the proposed northern evaporation ponds complex located in the Westlands North zone. The reused drainwater from Westlands Central and South reuse facilities would be conveyed via pipeline to a southern Se treatment facility located adjacent to the proposed southern evaporation pond complex located near the Westlands Central and South zone boundary.

Projections of the concentrations of drainage quantity and quality in the Se treatment feedwater are tabulated in Tables I-1 and I-2. The design flow rate for the treatment facilities are 16 and 17 cfs for the northern and southern treatment facilities, respectively. However, for costing and sizing of the treatment facility, flows of 19 and 21 cfs (16 cfs and 17 cfs times a 1.2 variability factor) were used for the northern and southern treatment facilities, respectively, to account for the redundancy of the treatment components required for maintenance and/or temporary shutdown.

Treatment would consist of the biological removal of Se. Biological removal uses anoxic conditions to convert selenate to elemental Se. Elemental Se has a low solubility and can be separated from solution using standard settling/clarification and filtration methods. If nitrate is present, it is an interfering substance. Nitrate does not interfere with the Se reduction mechanism; rather, it is the first material that will be removed under anoxic conditions. So the nitrate must be removed first before Se reduction can begin. In addition to Se removal the biotreatment system will remove nitrate and constituents that are associated with particulates in the treatment system. Anoxic conditions are typically defined as the condition where no dissolved oxygen is present and the only oxygen source is nitrate. Anaerobic conditions are defined as the absence of both nitrate and free dissolved oxygen. Se removal occurs in the region between the traditional definition of anoxic and anaerobic. The correct environmental conditions are created by adding a biological oxygen demand source to stimulate the growth of naturally growing bacteria that will reduce nitrate to nitrogen gas. The oxygen removed from the nitrate replaces free dissolved oxygen in the microbial reactions. Excess biological oxygen demand must be added to keep the conditions anoxic to anaerobic to stimulate Se removal.

I5 EVAPORATION PONDS

RO concentrate from the Northerly Area and reused drainwater from Westlands North reuse facility would be conveyed to the northern evaporation facility. Reused drainwater from Westlands Central and South reuse facilities would be conveyed to the southern evaporation facility. Some controversy exists regarding whether distributing the required pond area across a greater number of smaller ponds can reduce adverse environmental impacts. This issue can be addressed in the subsequent feasibility study. The quantity of influent drainwater, the influent concentration of Se, and the land area required for evaporation ponds are shown in Table I-3.

Table I-3
Influent Quantity, Selenium Concentration, and Land Required for Evaporation Ponds

Year	Influent Quantity (AF)		Influent Se Concentration (μg/L)		Land Required (acres)	
	Northerly Area & Westlands North	Westlands Central & South	Northerly Area & Westlands North	Westlands Central & South	Northerly Area & Westlands North	Westlands Central & South
1	5,700	0	63		1,200	0
2	5,690	650	67	21	1,200	140
3	5,670	940	71	23	1,190	200
4	5,640	1,230	76	24	1,190	260
5	5,620	1,520	81	25	1,180	320
6	5,600	1,810	85	27	1,180	380
7	5,790	2,100	90	28	1,220	440
8	5,990	2,390	94	29	1,260	500
9	6,180	2,680	99	31	1,300	560
10	6,370	2,960	103	32	1,340	620
11	6,450	3,230	108	34	1,360	680
12	6,580	3,490	108	34	1,390	730
13	6,710	3,740	109	34	1,410	790
14	6,830	3,990	109	34	1,440	840
15	6,960	4,240	109	34	1,460	890
16	7,080	4,490	110	35	1,490	950
17	7,210	4,740	110	35	1,520	1,000
18	7,340	5,000	110	35	1,540	1,050
19	7,460	5,250	110	35	1,570	1,100
20	7,590	5,500	111	35	1,600	1,160
21	7,710	5,750	111	35	1,620	1,210
22	7,840	6,000	111	36	1,650	1,260
23	7,970	6,260	112	36	1,680	1,320
24	8,090	6,510	112	36	1,700	1,370
25	8,220	6,760	112	36	1,730	1,420
26	8,350	7,010	112	36	1,760	1,480
27	8,470	7,260	113	36	1,780	1,530
28	8,600	7,510	113	37	1,810	1,580
29	8,720	7,770	113	37	1,840	1,630
30	8,850	8,020	114	37	1,860	1,690
31	8,980	8,270	114	37	1,890	1,740
32	9,100	8,520	114	37	1,920	1,790
33	9,230	8,770	115	37	1,940	1,850
34	9,350	9,020	115	37	1,970	1,900
35	9,480	9,280	115	38	2,000	1,950
36	9,610	9,530	116	38	2,020	2,010
37	9,730	9,780	116	38	2,050	2,060
38	9,860	10,030	116	38	2,080	2,110
39	9,990	10,280	117	38	2,100	2,170
40	10,110	10,540	117	38	2,130	2,220
41	10,240	10,790	117	38	2,160	2,270
42	10,360	11,040	118	38	2,180	2,320
43	10,490	11,290	118	39	2,210	2,380
44	10,620	11,540	118	39	2,240	2,430
45	10,740	11,790	119	39	2,260	2,480
46	10,870	12,050	119	39	2,290	2,540
47	11,000	12,300	119	39	2,320	2,590
48	11,120	12,550	120	39	2,340	2,640
49	11,250	12,800	120	39	2,370	2,700

The concentration of Se within the evaporation ponds increases during evaporation; however, other physical, chemical, and biological processes within the pond environment act to reduce the concentration of dissolved Se species. The magnitude of Se reduction that occurs through these processes appears to be related to site-specific conditions based on information derived from existing pond operations. These processes are not well understood and are not easily quantified or modeled. Therefore, estimates of the concentration of Se within the evaporation ponds are not presented although they are expected to remain substantially below the regulatory level of 1,000 ppb.

I6 MITIGATION FACILITIES

Mitigation habitat would likely be required to compensate for potential adverse physiological and reproductive impacts to waterfowl and shorebirds exposed to elevated Se levels (>2 ppb) within the evaporation ponds. These impacts would be considered especially significant for species protected under the Migratory Bird Treaty Act and the Endangered Species Act. Construction of Se-safe mitigation facilities would (1) provide attractive (to waterbirds) uncontaminated alternative foraging and nesting habitat, thus reducing overall contaminant exposure in the landscape surrounding the ponds and (2) compensate for documented cases of Se-related mortality and reproductive failure.

The quantity of land required for mitigation depends on the Se concentration within the ponds and other site-specific conditions, some of which would not be known until the ponds are operational and actual waterbird use can be monitored. Possible locations for the mitigation facilities are shown on Figure 5.5-2. Preliminary designs and costs for the mitigation facilities assume the following features:

- Half of each proposed mitigation facility would be developed into wetland habitat and half into uplands. Wetland habitats would consist of a mix of shorebird nesting and foraging habitat, seasonal (moist soil management) wetlands and semipermanent ponds for migratory waterfowl, and some permanent ponds. Upland habitats would consist of areas of native and nonnative grasses and/or shrubs, as well as irrigated areas producing small grains, corn, or other forage or cover crops suitable for waterfowl and other wildlife species.
- Approximately half of the area developed as wetland habitat would consist of shallow shorebird habitat similar to the mitigation wetlands developed by Tulare Lake Irrigation District for their evaporation ponds. The remaining wetlands would consist of seasonal, semipermanent, and permanent ponds maintained largely to benefit migrating waterfowl.
- All water supplied to the mitigation facilities would be of high quality (Se < 2 ppb) and would be obtained from water allocations acquired with irrigated land purchased for project purposes (e.g., reuse areas, evaporation ponds, mitigation lands). Based on a conservative conceptual design that incorporates the above mix of wetland and upland habitats, it is estimated that a total of 12,000 to 25,000 AF/yr would be required to operate and maintain the anticipated 3,200 to 6,400 acres of mitigation needed for the In-Valley Disposal Alternative's proposed 5,063 acres of evaporation ponds.

- Sites selected for mitigation facilities would have soil and groundwater properties suitable for wetland development and sustained long-term operation. Suitable properties would include appropriate permeability, soil and groundwater chemistry, and depth to groundwater.
- Electric fencing would be installed and maintained around the perimeter of shorebird nesting areas to exclude predators.

I7 REFERENCES

Bureau of Reclamation (Reclamation). 2001. Grassland Bypass Project EIS/EIR. Prepared for Reclamation and San Luis and Delta-Mendota Water Authority by URS Corporation. May.

URS Corporation. 2002. Draft Technical Memorandum, San Luis Drainage Feature Re-evaluation, Source Control. June 17.